

GOULD (G. M.)

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GENERAL MEDICINE.

BY

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FROM

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**THE RELATION OF EYE-STRAIN TO GENERAL
MEDICINE.¹**

BY GEORGE M. GOULD, M.D.,

OPHTHALMIC SURGEON TO THE PHILADELPHIA HOSPITAL.

LADIES AND GENTLEMEN: In response to your kind invitation to speak to you concerning some of the relations of Ophthalmology to general medicine, I have chosen one aspect of the subject that is at once most neglected, least understood, and important—to me, indeed, the most important. Other subjects may be more interesting, promise more brilliancy of treatment, or illustrate better one's special knowledge, but in your practice you will have a hundred cases of eye-strain to one of optic neuritis; a hundred of anorexia and malassimilation due to ametropia, to one of contraction of the field of vision; a hundred of nervousness and hysteria to one of hemianopsia or albuminuric retinitis. Moreover, without special training you will not be able to diagnose pathological changes in the fundus of the eye, whilst the recognition of an irritational eye-strain is relatively an easy task.

The essence of what I shall say to you to-night

¹ An address to the Philadelphia Hospital Medical Society, July 9, 1890.



will consist simply in pointing out a few classes of patients, to whom, if you do your duty, you will say, "Go to the oculist." Upon my part this may seem to you a bit of somewhat cunningly selfish advice; but I protest that the matter has certain very unselfish phases, and must, by both of us, be taken very seriously. I have, truly, had in my practice hundreds of patients who have had years, and even a life of daily anguish, because their physicians had not known enough to give them this advice.

The moral of my sermon, therefore, is that eye-strain is an enormously frequent, fertile, and unsuspected source of non-ocular disease. I beg of you not to let any long-eared prejudice blind you to this fact. Fact it is, and he who soonest recognizes it will do himself the more honor and the world the more good. I purpose speaking directly and solely from my own experience, and no fact has been so frequently and emphatically borne in upon me by every day's practice as that eye-strain is a great promoter and producer, first of functional systemic disease, and even, finally, indirectly of organic disease. And the correlate of that truth is this other, that the general physician makes no more frequent and bitter mistake than his indifference to or ignorance of it. To help you to avoid such errors let us try to answer these questions:

1. What is eye-strain?
2. What is its etiology?
3. How is it diagnosed?
4. What are its effects?

This is in accordance with the wise, old advice,

that prior to curing an evil we must know its nature, cause, extent, and results.

The term eye-strain is usually applied to the irritational incoördinations and abnormal exertions of the intra-ocular or extra-ocular muscles. The function of the eye is to form a perfect image of an object upon the retina in precisely the same way as a photographic camera does upon the sensitive plate. Strain arises when the eyeball is abnormally long, short, or curved, or when the muscles are not dynamically balanced. The term may be applied to the results of abusive use of the perfect eye, but that is not the common meaning. As defined above, the words need two criticisms. The first relates to an extension of the meaning so as to include nervous and centrally located phenomena. As commonly used the emphasis—indeed, the sole thought—concerns the muscles. But, the simple muscular over-use or strain is, if not entirely absent, at least often, and, I doubt not, generally, a small factor. Where else in the body does one find undue muscular exertion producing such effects as are the rule in eye-strain? The nearest analogy of so hard-worked a set of muscles consists of those implicated in scrivener's and piano-player's palsy. But the ciliary muscle is more over-worked than the muscles of the hand, whilst the effects are dissimilar. In other parts of the body you may have exhaustion, paralysis, localized soreness, myositis, etc., but never the mental, cerebral, and distant reflexes that are the rule in eye-strain. This is an indication, proved by other considerations, that the central neural, or cerebral, elements are predominant, and that the

muscular element *per se* is subordinate and *post hoc*. Failure to see this has led to the woful error of those extremists who cure all the ills that eyes are heir to by tenotomies—graduate and undergraduate. It is, indeed, a noteworthy fact that the patient complains little or not at all of ocular symptoms. In the greatest eye-strain the patient will heartily aver that the eyes themselves are perfect, and give no trouble. There are no pains, no soreness of muscles, no local symptoms whatever. This is an anomalous and interesting, but genuine, fact. I have partially tried to explain it elsewhere, and must pass it by at this time.

The second criticism refers to the origin of insufficiency, or lack of muscular balance in the external muscles. It is too commonly supposed that this is, as it were, congenital, or a positive cause of eye-strain. But it is certainly usually true that the insufficiency is a mere consequence of the ametropia. Correct the latter, and the muscle equilibrium is generally soon restored. Tenotomy, before a lengthy trial of this procedure, is no less than surgical barbarism. This, indeed, is a corollary of the fact that the insufficiency is a phenomenon of nerve centres and nerve forces, rather than of strengths or strains of muscle fibre. The acknowledged etiology of much insufficiency is the disturbance produced by ametropia of the normal relation between accommodation and convergence. But, this is patently a nervous phenomenon, pure and simple. The muscle chiefly strained in eye-strain, if any, would assuredly be the ciliary muscle. But, despite the Herculean tasks and torsions it often has to undergo, it does not

from these causes inflame, is not paralyzed, or weakened, but actually develops *de novo* a new set of fibres, almost a new muscle, called the Müller ring-muscle. Thus, from a variety of considerations we conclude that in eye-strain we have chiefly to do with nervous, not muscular forces. The facts to fix attention upon are dynamic, not static; neurological, not muscular; central, not peripheral.

As to the ametropia that produces eye-strain, it is almost entirely limited to two varieties, hyperopia and astigmatism. Simple myopia, unless widely differing in degree in the two eyes—*anisometropia*—produces no eye-strain. For other reasons it may be well to correct near-sightedness, but when you are simply trying to establish a differential diagnosis, you may be assured that if your patient is myopic to only a moderate degree, there will be no reflex neurosis for you as a general practitioner to combat. The danger from following this rule consists in the easy and terrible blunder made by opticians every day, of mistaking a so-called spasm of the accommodation, an astigmatism, or even a high degree of hyperopia, for myopia. As general physicians, however, you will not thus ruin eyes, because you will not prescribe spectacles.

Let us now examine more closely the mechanism whereby hyperopia and astigmatism produce eye-strain.

When the eyeball (antero-posteriorly) is too long—or, what amounts to the same thing, when the refracting powers of the ocular media are too strong—the natural focus of the entering light-rays is in front of the retina. This condition constitutes *myopia*,

and from the above explanation it becomes evident that there can be no strain, since the effort, if one may so speak, is to reduce strain. There is already too much refraction, and hence there can be no strain by the eye in attempting to overcome the condition. The rays need to be further dispersed, not more gathered together, and it is the greater gathering that requires an expenditure of nerve or muscular force.

When the eyeball is too short (or the media too weak in refractive power) the retina is in front of the natural focus, and the accommodative apparatus is put to an excess of effort to bring the focus forward, so that it shall be upon the retina. This is hyperopia. All good definition, as the photographers say, depends upon an accurate focalization of the rays from an object, whether upon the sensitive plate of the camera or upon the retina. In hyperopia the definition is only obtained by unceasing over-exertion. It is a Sisyphean task. The focus slips back from its proper position with every instant of inattention. When the object is near, as in reading and writing, the need of greater refracting power is increased or multiplied. This is because rays from near objects are more divergent than from more distant ones. Hence the greater strain in this condition, from near work, and the more marked increase of the whole train of pernicious symptoms when the hyperopic eye is forced to undertake it. The eye being naturally hyperopic, the task set for it by civilization becomes the more glaringly contrasted and severe. Upon the principles of American politicians the oculists and opticians should erect

the highest statue in the world to the inventor of printing.

Suppose, now, the cornea unsymmetrical, that is, unequally curved in different meridians, like the bowl of a spoon, the rays of the entering beam of light will be brought to a focus more quickly in the more curved meridian, and the retinal image proportionally blurred. This is *astigmatism*, and, of course, may complicate either myopia or hyperopia. If coexisting with hyperopia it produces the greatest strain.

We understand this by remembering that the ciliary muscle is a sphincter muscle, normally acting equally upon all sides by a common innervation. But with astigmatism, this muscle, or the central nervous system controlling it, seeks to neutralize the effects of the corneal asymmetry by unequal contraction, or excessively straining certain fibres in such a way as to cause the lens to react upon the traversing rays, so as to counteract the unequal influence of the corneal asymmetry. This action of the ciliary muscle is unphysiological, and as is readily seen, productive of a peculiar irritation.

Besides myopia and hyperopia, complicated or not with astigmatism, we may have presbyopia superadded. This consists of a growing inelasticity of the crystalline lens, or failure in the power of accommodation, which, increasing all through life, reaches in emmetropic eyes such a degree, at about forty-five years of age, that the artificial help of biconvex lenses is required for near work. If hyperopia be also present, presbyopia becomes apparent earlier, and proportionally to the amount of such hyperopia.

If myopia be present, then presbyopia comes on so much later.

In passing it may be asked why hyperopia and astigmatism, or eye-strain, seems so much more frequent now than formerly. The answer is clear, but apparently contradictory. It is this: hyperopia and astigmatism are probably less common now than ever before, and yet the direct result of these same defects, that is, eye-strain, is immensely more common. The explanation of this paradox is that the eye of animal, savage and child, is naturally hyperopic. Up to the present century the work of the eye has been adapted to the mechanism. But now, printing, schools, cities, sewing and commercialism have suddenly given the eye tasks for which it was never made, or to which it was never habited. The deity of natural selection never foresaw civilization. Great interest attaches to the inquiry how the eye is to react and adapt itself to meet the duty thrust upon it. One fact is evident: when the recognition of the enormous body of ill-results from eye-strain finally succeeds in battering down professional and popular prejudice, spectacles will be almost as common as noses. Nearly every one would be the better, intellectually, morally and physically, from the proper use of proper spectacles. There are extremely few emmetropic eyes. If from his occupation the farmer may be able to do without correction of ametropia, the farmer's child, if he goes to school, will not be able to do so. The greatest good of spectacles will be prophylactic. Thousands all about us are to-day suffering multiform and irremediable injury, directly or indirectly, because of unsuspected

eye-strain. The day will sometime come when a conscientious parent will never permit a child, however apparently healthy, to grow to puberty without a scientific examination of the eyes having been made, and repeated at intervals thereafter. The consequences of eye-strain are so subtle, so varied, so remote, so peculiar, so unforeseeable, and so harmful, that only by this plan can they be obviated.

How is the existence of hyperopia and astigmatism to be diagnosed—their existence, I say, not their amount? That either exists to a harmful degree is all you desire to know, but knowing this you also know that, until corrected, it is a permanent source of mischief, and that all remedies other than spectacles are palliative or useless. Many plans are advocated, but every one is objectionable. I take it for granted that you will not use the ophthalmoscope. For twenty years the general practitioner has been urged to do so, and for twenty years medical students have bought instruments that they never used after “swinging their shingles to the breeze.” I think their advisers gave bad, or at least useless advice. To use an ophthalmoscope properly requires much and continuous practice. The general practitioner soon finds he has not the time nor the patience, and the specialist who can do it better is close at hand. Whether the growth of specialism generally be for good or bad, it is quite certain to grow, and ophthalmology, of all the specialties, has always been pointed to as a model. The wise man accepts and makes the most he can of the inevitable.

Retinoscopy is a popular fad among my brethren: my advice to you is that you would better let us make mistakes with it. If you try to rely upon it you will utter either many falsehoods or many objur-gations—probably both. Proficiency in its use, as in that of the ophthalmoscope, requires special aptitude and training, and I do not believe that it is to be relied on as an accurate method even in the hands of its best friends.

Of many devices I shall recommend but one to you. Get two differently lettered cards of Snellen test-letters for distance, and hang them in your office, in a good light, fifteen or twenty feet from your patient. With every patient complaining of headache, neuralgia, or dyspepsia, with nervous, hysterical, choreic or anæmic symptoms, test accurately by one card, each eye separately, the ability to read. Keep a record of the lines read in each case. Then paralyze the accommodation with a six grain solution of homatropine. Half a dozen instillations within three fourths of an hour are sufficient, but it will be better to give the patient the drops, to be used every hour for a day. When he returns in one or two days, if the headache has in the meantime been better or has disappeared, you may be quite sure you have an eye-strain reflex. This, in fact, is the best method of differential diagnosis between headache due to eye-strain and that due to other causes. Since the great majority of all headaches is due to eye strain it is a point worth bearing in mind. But now, when your patient returns with thoroughly functionless accommodation, you will retest the acuteness of distant vision, using

a different test-card, to avoid the error arising from remembrance of the other letters. If this acuteness is markedly less than it was before using the mydriatic, that is, if only larger letters can now be read, you are convinced that hyperopia or astigmatism, or both exist. The amount of the defect is roughly estimated by the extent to which the visual acuity has fallen off. If originally normal, *i. e.*, if the twenty-foot line was read with each eye, and after paralysis of the accommodation it remains the same, you have a rare case of emmetropia. If originally subnormal, and after the mydriatic it remains the same, you have simple myopia. If you wish to tell whether the diminished acuity is due to hyperopia or to astigmatism, you can do so roughly by an astigmatic test-card. But this is a dangerous road, and for your purposes, one that you do not have to travel.

This plan seems to me the simplest and easiest of all for ascertaining the existence of eye-strain. It may be relied on absolutely, it demands no special training or superfine observation, no costly instruments or appliances. It tells you precisely what you need and want to know, and with little or no trouble. You should remember to warn your patient of the symptoms of mydriasis. Moreover, do not forget that with patients over fifty years of age, Time, that conquers all things, has pretty effectually paralyzed the accommodation, and other mydriatic is unnecessary. Before this age pathological reflexes have mostly subsided.

There is one aspect of this question that we must not overlook: How much lessened acuity, or how

much hyperopia or astigmatism is sufficient to set up eye-strain and pathological reflexes? This depends entirely upon two things, the nature and the occupation of your patient. If the patient be one of civilization's hot-house plants, a neurotic, sensitive, nimble-witted girl, the smallest defect is sufficient to play havoc with such a quivering bundle of nerves. If with such a case there is the slightest falling off of distant acuity under the mydriatic, if the same line of the test-type cannot be read just as easily, pack her off quick!

Between such a case and the rugged, phlegmatic out-of-door-living farmer there are a thousand degrees to tax the best judgment of the best oculist as to what to do. In general the young have less "lee-way" than the older, girls and women less than boys and men, the educated less than the uneducated, those doing much reading, writing, sewing, or other near-work, less than those not so busied. A farmer can safely carry for a lifetime five or ten times the defect that a city girl could endure for only a day.

One word more, despite your smile. Never send or allow your patient to be prescribed for by an optician. This disgrace to medicine and sin against humanity should be forbidden by law. Ruined eyes and inexpressible sufferings daily turn up in every oculist's office as the direct result of this execrable habit. If the oculist's fee is frightful, there are in every hospital ophthalmic departments where out-patients may be treated, free of charge, by competent hands.

I fear I have left myself too little space to speak of the essential or vital part of my subject. The

heart of the whole matter is as to the effects of eye-strain.

These may be divided into two chief classes, those limited to the eye itself, and those presenting systemic or extra-ocular results. The first class concerns particularly the ophthalmic specialist, but it is well to note them as we pass by. Some of them serve as pointers, or clear indications of the ametropia. In children, especially boys, styes, blepharitis, and conjunctivitis, often mark the deep-seated trouble. The most common ocular symptom is accommodation-failure. The ciliary muscle temporarily relaxes under the strain, and the words of the printed page blur, and run together, and the eyes must be closed for a moment. Such failures occur more frequently if near-work be persisted in, and may be accompanied with conjunctival injection, pains, flow of tears, spasmodic blinking, or "tic" of the lids, face, etc. Among the organic changes produced by eye-strain is myopia. This may sometimes be caused by changes induced by ametropia, whilst insufficiency and strabismus are almost certain proofs of this cause. A still more profound injury is one that I have pointed out to the profession—a chronic macular choroido-retinitis, with pigmentary changes about the posterior pole, lessened visual acuteness, etc. Thus the eye itself may be irretrievably injured by uncorrected eye-strain. It is not true that so long as none of the palpable symptoms appear the condition of the eyes may be ignored. Many of these symptoms are so subtle as not to be noticed until the disastrous result is accomplished.

It is doubtless true that eye strain plays an etiological rôle in the production of cataract.

Turning now to the more widespread systemic abnormalism and disease produced by eye strain, we are struck by the awful, discouraging, exasperating slowness with which even the most glaring consequences are ignored, with what intolerable difficulty this knowledge pounds its way through prejudice and ignorance, both lay and professional. Take headache as the best example. The "common people" are to-day more alive to the fact of its true causation than their doctors. Most medical articles on the subject, and books on practice, either ignore the eye strain or allude to it as a minor factor. The fact, of course, is that it is far more frequently the cause than all others put together. I do not doubt that ninety cases out of one hundred are due to eye strain. In my first series of one thousand refraction cases in private practice a chief complaint in more than eight hundred was of headache. The failures to cure or greatly relieve were not over half a dozen. Eye strain headaches, or neuralgias, as they are sometimes called, may usually be diagnosed by the following considerations:

1. The patient, nine times in ten, is a girl or woman.

2. In the great majority of cases the patient locates the pain in the forehead or temples, or says it starts there.

3. If the headache is not continuous it is usually brought on or made worse by near-work—is greater, for example, during the school season than in vacation, during school hours than holidays, etc.

4. The headache is frequently associated with anorexia, fickleness of appetite, malassimilation, or some other digestional abnormality, all these being **common eye-strain reflexes.**

Sick-headache, there can be little doubt, is very often, if not generally, due to eye-strain, though it, like any other functional abnormality, may not be quickly curable by stopping the cause after continuance for half a lifetime.

Fits of nausea and vomiting are not infrequently produced, and I have now had six or eight cases of pronounced "car-sickness," which never returned after getting spectacles. I had one patient last week who was intensely sick with vomiting, dizziness, etc., for twenty-four hours following every street-car ride. She walked twenty squares to see me. I sent her home, with paralyzed accommodation, upon the street cars, without a return of the usual effects. One wonders if sea-sickness is not more or less connected with ocular functions. A physician wrote me from the West that he could produce giddiness and nausea in himself by rolling his eyes upward in a peculiar manner. One of my patients can read without trouble while sitting up, but gets sick at his stomach at once if he reads lying down.

But the cerebral evidences of irritation and disorder, however marked and clear, are of less importance than others that strike at the nutrition and welfare of the whole organism. The war must be carried into Africa! *Deus vult Carthago!* Despite all disbelief, prejudice, and the smiles of superior wisdom, it is my well-proved and deep-rooted conviction that eye strain very frequently

produces digestive troubles of various kinds, all resulting in malnutrition. Those who ten or twenty years ago preached the ocular origin of headache, encountered the same wall of prejudice as one does now in reference to this aspect. I shall not attempt to explain the mechanism of this reflex neurosis, that of any such reflex is not wholly clear, but it is certainly as easily understood as a metastatic orchitis in mumps. Whether understood or not, if you will bear the fact in mind you may save yourself much vexation and your patient much suffering by testing the eyes of many an anæmic, nervous, dyspeptic girl, whose trouble you cannot account for or cure. I have had very many such patients freshen up at once upon getting spectacles, and in a month or two gain ten or twenty pounds in weight, without any medicine, and after years of other treatment. It seems at first sight the extreme of absurdity to say that anemia may be due to eye-strain, yet such is the fact, because nothing can shake my conviction that malnutrition may be caused by it, and anemia is only the consequence of persistent malnutrition. In girls and young women with severe eye-strain, fickle and poor appetite is almost always an emphatic complaint. Their mothers nickname them "pick-ers." I know well enough the tricks of *post hoc propter hoc* logic, but if such patients return in a month or two with better health patent in every feature, and now eating three meals a day, I trust my conclusions. The iron on their noses in the form of spectacle frames has done the red blood corpuscles more good than it would have done in pills.

It is by thus producing continued anorexia and

malnutrition that eye-strain may indirectly lay the foundation for other evils that else had not existed. The headache, hyperæsthesia, or nervous exhaustion, brings the organism just to such a degree of weakened vitality that further resistance is impossible, and the upspringing of latent or inherited diseases of many kinds and of differing degrees of fatality is permitted. No lesson is more clear now-a-days than that disease germs find a nidus only where vitality is subnormal.

Two indirect proofs of the power of spectacle lenses to prevent these results are at hand: First, put a pair of spectacles before your normal eyes that will create an eye-strain such as others have without glasses. Headache, dizziness, and vomiting will in a few hours teach a very practical lesson. Second, note this: A spectacle gets broken, and in twenty-four hours the patient returns with a terrible recurrence of the old but long unknown trouble, the headache, the nausea, the unrest, etc. If an astigmatic lens gets bent a small fraction of an inch out of its proper place, there is the same phenomenon. A visit to the optician is all that is needed.

All the reflexes of eye-strain are primarily phenomena of increased nervous action. They are peculiarly central in character, and may perhaps be considered as a struggle of the ocular and optical centres to translate into sensations imperfect retinal stimuli or optic-nerve messages, as well as to react upon the eye itself so as to perfect its function. With hyperopia and astigmatism present this becomes an irritating and harassing labor, disturbs the equilibrium of the cerebral centres, and liberates

large excesses and incoördinations of nerve force. These unregulated discharges overflow the normal outlets, and produce results varying according to the somewhat accidental routes, and the commissural fibres over which the superabundant discharges pour upon centres incapable of resistance. If the phrenic-nerve centre is flooded, the diaphragm is stimulated to excessive action, and vomiting or other disturbance follows. In connection with this I may mention the case of one of my patients, Mrs. G., who had suffered for twenty years with a persistent and harrowing flatulent dyspepsia, for which many physicians had been consulted, and limitless quantities of medicine had been taken. I speak advisedly when I say that the minute proper glasses were applied the frightful eructations and discomfort stopped. If the glasses are left off a minute or two the diaphragm begins its spasmodic action. If the innocent overflooded centres happen to be inhibitory centres the results are in accord with the function of those centres. Possibly the digestive torpor and malassimilation are explainable as an unregulated stimulation of the pneumogastric. I reported a case last year in which violent rapidity of the heart's action came on with outrageous abuse of hyperopic eyes, and persisted despite all treatment until correcting spectacles were found, then suddenly subsided. Another noteworthy illustration was that of Miss U., who had suffered from periods of aphonia for years. The mydriatic brought the voice back, and the glasses have assured the cure. I have had several cases of non-appearance of menstruation, amenorrhœa, and dysmenorrhœa, in which the proper function was

established at once upon the use of spectacles. Two patients had periods of partial paralysis and anaesthesia of the limbs prior to coming to me. These instances of derouted reflex action are characterized by appearing at more or less regularly recurring periods with increasing headache and sometimes with "blind-spells," or other ocular symptoms.

Generally speaking, the excess of irritational stimulus results in positive overstimulation of motor centres. In a large class it will manifest itself as a diffuse abnormal activity. The child or young person is simply "nervous," restive, cannot keep still, will not stick to studies, etc. If the derouted reflex take more specialized channels certain muscles or groups are acted upon, and simple chorea follows. One girl wore out the right shoe in a few weeks by excessive scraping of the foot. A boy was always snuffing or making grimaces with the lips. Tics of the cheek muscles and jerking of the hand or arm are also met with. I have had quite a number of cases of pronounced chorea cured at once by correction of ametropia. I have had no experience with epilepsy or insanity. If I had a case of *petit mal* I would try prolonged mydriasis. Very frequent symptoms of eye strain are insomnia and night-terrors. The child rolls, cries out in its sleep with fright. The surcharged cerebral centres after the day's warfare are for a long time unable to reach a condition of normal equilibrium. I have more than half a belief that emuresis may sometimes be traceable to the same irritation.

It may be thought that the reports of many of such cases as the above are to suffer revision in the

light of one error common to all—hysteria. The old pianoforte tuners swept all the discords into one octave that was called *the devil*, and this was avoided as much as possible in playing. There was a time when, whatever was not understood, or not easily curable in female nervous disease, was called hysteria. It was a convenient cover for professional failure in therapeutics. I have no doubt that many, very many such cases needed, and still need, a pair of proper spectacles, instead of sneers and *pilulæ asafœtidæ*.

One final illustration and I have done. The common-school system as now carried on is largely responsible for a deal of suffering such as I have described. Children are forced to needless and unhealthful study, and manufactured into sorry examples of intellectual *pâte de foie gras*, namby-pamby mimics and memorizers when they should be in training to make of them healthy young animals. Under this system of over-pressure and sham education the civilized eye, like many another product of civilization, is a poor and pitiable thing. Its little possessor, sadly unconscious of what is the matter, goes on with high pressure, and ambition, and tonics, until one after another the strings of life snap under the high tension. If not so, he finds study becoming irksome, and the parents grieve as they painfully watch intellectual capacity slowly and persistently renounced and life shunted into the world's humdrum and routine. Eye-strain has thus derouted many a natural genius, subtly turning him from intellectual culture to physical but less painful outlets for his activity.

The multiformity and apparent exaggeration of the effects of eye-strain indicated above may seem less extravagant if we remember how vital the function of vision is to every act, how necessary to every minute's safety of the organism, how uninterruptedly active during every instant of waking life. Not only every act, but every emotion and thought—intellect itself, and imagination, are born of or bound up with visual acts and results. The very letters of the alphabet are conventionalized pictures of things. Mind is incarnate and concentrate seeing. The visual centres of the brain are in the closest and most vital connection with all other brain centres. How easily, therefore, must a disturbance of the peripheral mechanism send a jarring and discordant thrill throughout the entire motor, sensory, and psychic being. At once the microcosm is aroused to correction and adjustment: subordinate and commissurally connected centres feel the challenge and the overflow according to the accidents of weakness, diathesis, disease, and their varying powers of resistance. The result of this overflow, or switching, is a reflex neurosis, and from the supreme importance of the function of vision and the unusual strain that civilization puts it to, the eye becomes the greatest originator of these disturbances.

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